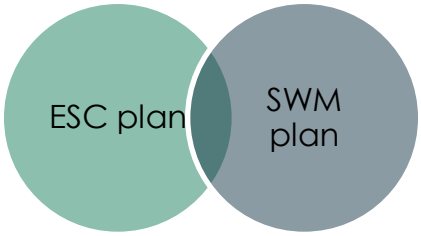
Module 5: Common BMP Construction Inspection Points

Objectives

- Recognize critical features of BMPs
- Identify and prioritize key BMP inspection points
- Identify common signs of BMP failure during
- Describe common inspections elements across the 15 non-proprietary BMPs

5a. Common BMP Inspection Points

The erosion and sediment control (ESC) plan and stormwater management plan are interconnected and must both be followed for the successful installation and function of BMPs. It's important that inspectors consult both the ESC plan and the SWM plan to identify:



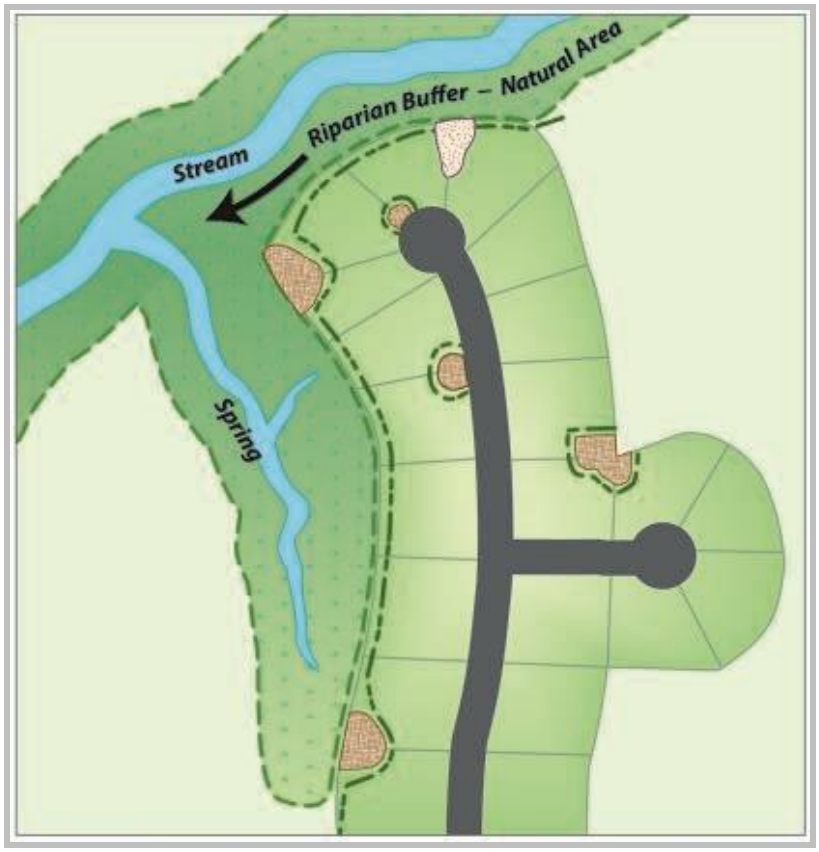
- Co-located practices
- Installation timing
- Materials

CO-LOCATED PRACTICES

During construction, some post-construction stormwater BMPs will be ***co-located*** with ESC practices. This means that during construction a practice will serve as an ESC practice and then during the final stages of construction, it will be converted to a post-construction stormwater BMP.

Example of co-located practices: sediment basin conversion to a constructed wetland

Examples of co-located and non-co-located practices



Co-Located construction-phase sediment basin and post-construction BMP

Post-construction bioretention/infiltration area
Soil must be protected during construction.
Do **not** use for construction-phase BMPs

Limits of Disturbance (LOD) for construction-phase SWPPP – Must protect Riparian Buffer and post-construction infiltration area. Fencing recommended.

Riparian Buffer/Natural Area

Typically, BMPs that rely on infiltration should not be co-located with ESC practices because of the compaction that results from the ESC practice holding stormwater and sediment. If a BMP is not co-located with an ESC practice, then it is important for the future success of the BMP that the operator follows any protective measures listed in the ESC or SWM plan to keep equipment off the area and keep stormwater and sediment out.

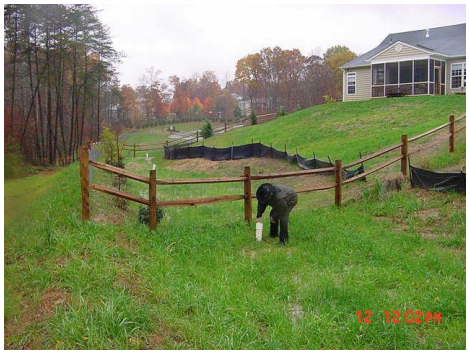
INSTALLATION TIMING

Consult the construction sequence in the stormwater management plan to determine when a BMP should be installed. As the inspector, you want to make sure the BMP has not been installed before the ***contributing drainage area has been stabilized*** and that stormwater is being kept out of the practice until the practice has been stabilized. The drainage area must be stabilized so that sediment does not clog the BMP.

Important inspection points:

- Has the contributing drainage area been stabilized?
- Are ESC practices being used to keep stormwater out of the BMP until it's stabilized?
- Are co-located practices in multi-phase projects (e.g., residential subdivision) converted at the correct time?

Drainage area was not stabilized before these practices were installed. As a result, both practices need to be replaced.



Silt fence is used in this picture to keep sediment out of the dry swale while the swale stabilizes.

Inlet is temporarily blocked during installation of this bioretention practice.

Inspectors should consult the SWM plan for the construction sequence to determine when practices in multi-phase projects should be converted. When it's time to convert the practice, appropriate ESC practices should be in place to keep out upstream sediment.

MATERIALS

BMPs will not function properly if the wrong materials are used or if correct materials are improperly used or prepared. Consult the SWM plan to verify the correct materials are being used and applicable instructions are followed.

Important inspection points:

- Correct type of soil media (topsoil, bioretention soil, wetland soil)?
- Is the soil media the right composition (sand, soil fines, and organic matter)?
- Is filter fabric being used instead of geotextile fabric? Is the correct geotextile fabric being used?
- Does the vegetation match the planting plan?
- Is the stone the correct size and is it washed?

	
The correct soil media is vital for proper infiltration.	***Geotextile*** is a permeable textile material used to increase soil/structural stability, provide erosion control or aid in drainage (e.g., used on sides of bioretention and infiltration facilities). ***Filter fabric*** is used to contain/filter smaller soil particles (e.g., silt fence).
	
Do the plants match the planting plan?	Is stone clean, proper size, and proper diameter?

5b. Permit Termination Inspections

PERMIT TERMINATION CHECKLIST

When an operator is ready to terminate their Construction GP coverage, they submit the DEQ Notice of Termination form to the VSMP authority. Before entering the information on the form into the Construction GP System, the VSMP authority should confirm the following has been completed:

Permit termination checklist

- ☑ Permit termination requirements met
- ☑ DEQ Notice of Termination form completed
    - Confirmation long-term maintenance agreement(s) recorded in local land records (when applicable)
    - Information on permanent control measures recorded (when applicable)
- ☑ Construction record drawing(s) for permanent stormwater management facilities submitted to VSMP authority (when applicable)
- ☑ Notice of Termination information entered into Construction General Permit System

Permit termination requirements

(9VAC25-880-60)

The operator must submit the DEQ Notice of Termination form to the VSMP authority within 30 days of meeting one or more of the following conditions:

1. Necessary permanent control measures included in the SWPPP for the site are in place and functioning effectively and ***final stabilization*** has been achieved on all portions of the site for which the operator is responsible. When applicable, long-term responsibility and maintenance requirements for permanent control measures must be recorded in the local land records before the submission of the Notice of Termination;

2. Another operator has assumed control over all areas of the site that have not been fully stabilized and obtained coverage for the ongoing discharge;
3. Coverage under an alternative VPDES or state permit has been obtained; or
4. For residential construction only, temporary soil stabilization has been completed and the residence has been transferred to the homeowner.

When the operator submits a Notice of Termination for conditions one and four above, it's important for the inspector to go to the site to verify the termination requirements have been met.

Note:
The DEQ Notice of Termination form can be downloaded from:
http://www.deq.virginia.gov/Portals/0/DEQ/Water/Publications/CGPNoticeofTermination2014.pdf

Final stabilization
(9VAC25-880-1)

Final stabilization is defined in the Construction GP as meeting one of the following three conditions:

1. All soil disturbing activities at the site have been completed and a permanent vegetative cover has been established on denuded areas not otherwise permanently stabilized.

   Permanent vegetation shall not be considered established until a ground cover is achieved that is ***uniform*** (e.g., evenly distributed), ***mature enough to survive***, and ***will inhibit erosion***.

2. For individual lots in residential construction, final stabilization can occur by either:
   a. The homebuilder completing the final stabilization criteria specified in 1 above; or
   b. The homebuilder establishing temporary soil stabilization, including perimeter controls for an individual lot prior to occupation of the home by the homeowner, and informing the homeowner of the need for, and benefits of, final stabilization.

3. **Lands used for agricultural purposes:** Final stabilization may be accomplished by returning the disturbed land to its preconstruction agricultural use.

   Areas not previously used for agricultural activities (e.g., buffer strips immediately adjacent to surface waters) and areas not being returned to preconstruction agricultural use: Final stabilization criteria specified in 1 or 2 above.

Important BMP inspection points for permit termination

As stated above, one of the permit termination requirements is for the operator to confirm the necessary permanent control measures (BMPs) from the SWPPP are in place and functioning effectively. The inspector can confirm this by conducting a final inspection of the site's BMPs before permit termination.

The following is a list of common BMP inspection points:

- Is water getting into the practice?
- Any signs of erosion in or around the practice?
- Is sediment getting into the practice?
- Is vegetation growing?
- Does the practice drain correctly?

Is water getting into the practice?  Water is bypassing the inlet.	**Any signs of erosion in or around the practice?**  Erosion at the inlet and uneven ponding.
Is sediment getting into the practice?  Sediment in the bottom of a grass channel.	**Is vegetation growing?**  Vegetation looks healthy.

Does the practice drain correctly?

Standing water on permeable pavement

LONG-TERM MAINTENANCE AGREEMENTS

(9VAC25-870-112)

Permit termination checklist

- ☑ Permit termination requirements met
- ☑ DEQ Notice of Termination form completed
  - Confirmation long-term maintenance agreement(s) recorded in local land records (when applicable)
  - Information on permanent control measures recorded (when applicable)
- ☑ Construction record drawing(s) for permanent stormwater management facilities submitted to VSMP authority (when applicable)
- ☑ Notice of Termination information entered into Construction General Permit System

The long-term responsibility for and maintenance of stormwater management facilities and other techniques specified to manage the quality and quantity of runoff requirements must be set forth in an instrument recorded in the local land records prior to state permit termination or earlier as required by the VSMP authority. At a minimum, the agreement must:

- Have had the initial terms submitted before the approval of the stormwater management plan;
- Be stated to run with the land (will transfer to a new owner);
- Provide for all necessary access to the property for purposes of maintenance and regulatory inspections;
- Provide for inspections and maintenance and the submission of inspection and maintenance reports to the VSMP authority; and
- Be enforceable by all appropriate governmental parties.

Inspectors can use the maintenance agreements for post-construction inspections given that they will include the detailed provisions required to maintain effective BMP functionality. See

Module 7 for the typical information that would be included in a long-term maintenance agreement.

In many VSMP authorities, the plan reviewer will ensure the long-term maintenance agreement is sufficient for the site. Any changes that occur to stormwater management facilities following plan approval and/or that may be reflected on construction record drawings may require inspectors and plan reviewers to collaborate to ensure consistency is maintained with the final long-term maintenance agreements. The most effective maintenance agreement is site-specific for the particular BMPs that are used on a site as well as any conditions that are unique to that site (e.g., the presence of steep slopes that should be inspected for soil stability).

CONSTRUCTION RECORD DRAWINGS (AS-BUILT DRAWINGS)

Permit termination checklist

- ☑ Permit termination requirements met
- ☑ DEQ Notice of Termination form completed
    - Confirmation long-term maintenance agreement(s) recorded in local land records (when applicable)
    - Information on permanent control measures recorded (when applicable)
- ☑ Construction record drawing(s) for permanent stormwater management facilities submitted to VSMP authority (when applicable)
- ☑ Notice of Termination information entered into Construction General Permit System

Construction record drawings, or as-builts, serve as verification that stormwater management facilities have been installed according to approved SWM plan. They must be sealed and signed by a professional registered in Virginia (9VAC25-870-55). Construction record drawings are a critical element for post-construction inspections. Although the acceptance of construction record drawings is primarily a plan reviewer function, inspectors can play a key role in confirming their accuracy. They can also add documentation to the file that might be useful for maintenance inspections.

Confirmation of construction record drawings can be by construction inspections and related records and/or photo-documentation at key points during BMP installation. Construction record drawings and supporting documentation may help answer questions when future maintenance issues are identified. This is particularly important for co-located practices.

An as-built survey can be broken down into three components:

1. Earthworks specifications
2. Material specifications
3. Dimensions and elevations survey

The items noted within these components should be checked visually when possible and by reviewing documentation to substantiate that the SWM BMP has been constructed in accordance with the approved plan and specifications.

1 Earthwork Specifications

The acceptable completion of earthwork in the construction of a stormwater management facility is crucial in assuring that a facility is structurally sound. This category covers all aspects pertaining to the completion of earthwork for a facility. It is essential that specific elements of the construction inspection, as well as the pre-construction feasibility analysis of the soils, be documented. This may include compaction tests, inspections of the removal of unsuitable materials under and adjacent to the embankment foundation, construction of the cut off trench and other seepage control measures, compaction around the barrel, riser structure footing, and any other element that is hidden in the final condition. All work should be completed under supervision of a licensed geotechnical engineer. The inspection logs and test results should be included in the final as-built survey.

Geotechnical/Geophysical Testing

The examination of existing underlying strata indicates the composition of that strata and if that strata will support a stormwater management facility. For example, the presence of bedrock at the natural ground surface or in "cut" provides a plane of weakness that to which water may follow or exfiltrate. This is especially critical in areas of karst. Also, the presence of organics or other unsuitable materials under the embankment and embankment footing may require additional excavation. This must be documented as having been completed.

Normally, in non-karst terrain (east of the Blue Ridge), simple geotechnical logs taken at the SWM site will provide adequate interpretative results. However, in karst environments it is extremely useful that the testing be expanded to geophysical (seismic) evaluation. These tests provide images of underlying strata and indicate the presence of anomalies. This is critical since limestone geology exhibits extensive caves and cavities where ponding of runoff may exacerbate collapse of underlying cavities, which ultimately results in extremely expensive repairs.

Fill Classification

The geotechnical portion of the approved plan should provide a listing of soil classification types that are suitable for use at the project infill. Specialized criteria may also specify the classification of impermeable soil to be used for clay liners in areas of sandy soils or karst. Fill soils containing such materials as excessive or large rock, organic material or "fatty clay" (CH) classification are not acceptable due to the inability to achieve proper compaction or because of their shrink-swell properties. Verification must also be provided that the materials used in construction of drainage and filter diaphragms comply with the approved plan specifications.

Compaction

The application of "lifts" in proper thickness and density is essential in attaining a stable SWM structure. The compaction of dam embankment to a percentage at or above the percent compaction specified in the approved plan and within the optimal range of moisture content assures that there will not be adverse settlement of the embankment. Careful compaction in areas adjacent to the barrel and seepage control measures is

critical to eliminate excessive "void space" along the outlet barrel where the potential for embankment failure is high. Sufficient test results should be retained to document uniform compaction of the dam embankment and density/permeability of **existing soil formation and/or soils to be** used for liners (where applicable), in accordance with the approved plan.

2 Material Specifications

Construction materials may be classified as those items other than earthwork. A large number of component items needed for the construction of stormwater managmenet facilities are grouped into this category. Some of these components must be inspected during installation. Materials would include, but not be limited to, concrete, reinforcing steel, concrete pipe, metal pipe, woodwork, masonry, and any other items that are applicable to the facility and satisfy all the requirements of the VSMP program. The following provides a general discussion of some of the components of a stormwater management facility:

Riprap and Aggregate

The size distribution (diameter of aggregate), the amount of "fines" and integrity of rock may be factors, since aggregate sizing should be in accordance to the plan.

1) Aggregate sizing plays a role in two distinct areas. In underground reservoir use, the size of aggregate dictates the amount of void space available for infiltration or retention/detention of runoff. In riprap use, the minimum size is critical in maintaining stability during high velocity flow, while a size in great excess of the stone specified may be equally as detrimental in regards to aesthetics and/or proper placement.

2) The amount of fines contained within aggregate is generally a visual observation, although quarry delivery tags should bear out the specifications. The percentage of fines generally is important where washed stone is to be utilized for an underground aggregate reservoir, or where the outlet protection of a facility is discharging into a stream or other sensitive area that is susceptible to turbidity.

3) Rock integrity and shape is generally the visual observation that the aggregate used will meet specifications without long term decay. For example, sandstone does not make good riprap since it may be expected to disintegrate over time. Slate usually exhibits cleavage planes and therefore lays flat. When used for outlet protection, insufficient surface roughness of the slate may not dissipate concentrated flow energy.

Control Structure

There are an infinite number of design configurations for a control structure. Whatever the design, there should be project specifications for dimensions, strength and specific materials in accordance with the specifications found in the particular BMP Design Specification and any other local requirements. Appropriate documentation from the manufacturer should be retained (as applicable) to document each component. For example, pre-cast concrete risers normally arrive with as-built shop drawings that indicate specifications of the item furnished. Where components are constructed at the site, such as a cast in-place riser footing, test information and/or delivery tags from the concrete plant should be retained, while rebar reinforcement and dimensional information is documented in the construction log. Other items normally applicable to the control structure include:

1) An outlet barrel, normally affixed to the control structure, is used to convey flow to an accepted discharge point. Items related to proper conduit installation include the procedure used in sealing joints of conduit together, the method of attachment to the control structure and the use of inlet and floor shaping (as applicable) within the control structure.

2) There is also a need to inspect and document the existence, location and spacing of anti-seep collars, concrete cradles or other seepage control measures (at the outlet barrel) as specified in the approved plan. Documentation should include verification of critical dimensions, existence of reinforcement, and indication of concrete mix strength. In the case of filter diaphragms, both earthwork and materials need to be considered in the installation.

3) Trash racks of varying design and construction are normally affixed to a control structure and in some cases inlets which “feed” the SWM facility. Visual

observation (with inspection log entry) should indicate bar size, spacing grate configuration, and proper attachment to the control structure, or inlet and the application of rust resistant coating to the same where applicable.

Geotextiles

Synthetic fabrics are frequently specified for application beneath various components, under riprap or individually in spillways or for low flow channels. Proper selection of a manufacturer's product along with installation consistent with the plan and/or manufacture's directives is necessary to assure the performance intended. The method of installation should be observed and a tag provided from the product that verifies compliance with the product specification given in the approved plan.

Conveyance System Components

One portion of a stormwater management design that is frequently overlooked in inspections is the collection of components comprising the drainage system for the site. It is obvious that if the system is not built as intended in the approved plan, then the facility may not function as expected. Critical items such as conveyance conduit diameter, slope, inlet and grate length/configuration are essential to insure that the required design storm (generated by the contributing drainage area) is adequately conveyed to the stormwater management facility for control and/or that runoff from other drainage areas is diverted away from stormwater management facilities.

3 Dimensions and Elevations Survey

The approved plan provides detailed information for specific elevations such as the inverts of the outlet conduits, control orifice and weir invert elevations, invert of emergency spillway, top of the dam, as well as pond bottom and slope of the same. Additional dimensional information exclusive of the control structure should also be provided. This could include the dimensions of the impoundment area at specific elevations and the top width and side slope of a dam embankment. The purpose of the as-built survey is to confirm that elevations and dimensions are consistent with the approved plan.

Construction record drawing submittal requirements

As-built information should be documented and submitted to the VSMP as follows: (1) a copy of the applicant's inspection log book; (2) a red-line revision of the approved SWM plan sheets; and (3) certification by a qualified professional that the as-built plan conforms to the approved plan.

1. Inspection Log Book

A copy of the inspection log book should be kept at the project site. The log should document all aspects of the construction of the facility (with copies of applicable test results) to insure compliance with the approved plan. Any significant inconsistencies should immediately be reported to the engineer for evaluation and possible modification.

2. Red-Line Revision of Plans

Red-line revision plans should be submitted upon completion of the facility. The plans should indicate any changes to the approved plan. Items that differ from the original approved plans and computations should be shown in red on both the plans and computations as follows:

- A red check mark must be made beside design values where they agree with actual constructed values
- For changed values, "line out" the design value and enter the actual value in red
- Elevations to the nearest 0.1-foot are sufficient
- A stage-storage summary table, comparing the design values and the as-built values, should be provided for each facility with a storage volume

3. Certification Statement

The project owner should have those persons responsible for the inspection and implementation of the plan submit written certification that the SWM facility(s) and conveyance system have been built in accordance to the approved plan since this will cover underground facilities as well. Survey work during stake out and construction should be documented to verify underground volumes, elevations, pipe sizes, etc.